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	PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.

11. TITLE (Include Security Classification)
DEPARTMENT OF DEFENSE ANNUAL REPORT ON CHEMICAL WARFARE-BIOLOGICAL DEFENSE RESEARCH RESEARCH PROGRAM OBLIGATIONS

12. PERSONAL AUTHOR(S)

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
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16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	OBLIGATIONS	PUBLIC LAW 91-121	FY 75
15	02		CHEMICAL	PUBLIC LAW 93-608	
			BIOLOGICAL	PUBLIC LAW 97-375	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Public Law 93-608 requires the Department of Defense to make an annual report to Congress on the funds obligated for chemical warfare and biological defense research and procurement programs.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT
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21. ABSTRACT SECURITY CLASSIFICATION
UNCLASSIFIED

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JANIS D. CHASE	(202) 694-2153	DAMA-CSS-C

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted. All other editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

INSTRUCTIONS FOR PREPARATION OF REPORT DOCUMENTATION PAGE

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Block 5. Monitoring Organization Report Number(s): Enter the unique alphanumeric report number(s) assigned by the Monitoring Agency. This should be a number assigned by a DoD or other government agency and should be in accordance with ANSI STD 239.23-74. If the Monitoring Agency is the same as the Performing Organization, enter the report number in Block 4 and leave Block 5 blank.

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Block 6b. Office Symbol: Enter the office symbol of the Performing Organization.

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If the report is in a foreign language and the title is given in both English and a foreign language, list the foreign language title first, followed by the English title enclosed in parentheses. If part of the text is in English, list the English title first followed by the foreign language title enclosed in parentheses. If the title is given in more than one foreign language, use a title that reflects the language of the text. If both the text and titles are in a foreign language, the title should be translated, if possible, unless the title is also the name of a foreign periodical. Transliterations of often used foreign alphabets (see Appendix A of MIL-STD-847B) are available from DTIC in document AD-A080 800.

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List all authors. If the document is a compilation of papers, it may be more useful to list the authors with the titles of their papers as a contents note in the abstract in Block 19. If appropriate, the names of editors and compilers may be entered in this block.

Block 13a. Type of Report: Indicate whether the report is summary, final, annual, progress, interim, etc.

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Block 17. COSATI Codes: This block provides the subject coverage of the report for announcement and distribution purposes. The categories are to be taken from the "COSATI Subject Category List" (DoD Modified), Oct 65, AD-624 000. A copy is available on request to any organization generating reports for DoD. At least one entry is required as follows.

Field - to indicate subject coverage of report

Group - to indicate greater subject specificity of information in the report.

Sub-Group - if specificity greater than that shown by Group is required, use further designation as the numbers after the period (.) in the Group breakdown. Use only the designation provided by AD-624 000.

Example: The subject "Solid Rocket Motors" is Field 21, Group 08, Subgroup 2 (page 32, AD-624 000)

Block 18. Subject Terms: These may be descriptors, keywords, posting terms, identifiers, open-ended terms, subject headings, acronyms, code words, or any words or phrases that identify the principal subjects covered in the report, and that conform to standard terminology and are exact enough to be used as subject index entries. Certain acronyms or "buzz words" may be used if they are recognized by specialists in the field and have a potential for becoming accepted terms. "Laser" and "Reverse Osmosis" were once such terms.

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For reference on standard terminology the "DTIC Retrieval and Indexing Terminology" DRIT-1979, AD-A068 500, and the DoD "Thesaurus of Engineering and Scientific Terms (TEST) 1968, AD-672 000, may be useful.

Block 19. Abstract: The abstract should be a pithy, brief (preferably not to exceed 300 words), factual summary of the most significant information contained in the report. However, since the abstract may be machine-searched, all specific and meaningful words and phrases which express the subject content of the report should be included, even if the word limit is exceeded.

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DEPARTMENT OF DEFENSE

ANNUAL REPORT ON CHEMICAL WARFARE AND BIOLOGICAL RESEARCH PROGRAMS

(1 JULY 1975 THROUGH 30 SEPTEMBER 1976)

15 NOVEMBER 1976

DEPARTMENT OF DEFENSE
ANNUAL REPORT ON CHEMICAL WARFARE AND
BIOLOGICAL RESEARCH PROGRAM OBLIGATIONS
FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976
RCS DD-DR&E(SA) 1065

(ACTUAL DOLLARS)

	ARMY	NAVY AND MARINE CORPS	AIR FORCE	TOTAL
CHEMICAL WARFARE PROGRAM	$ 48,883,000	$ 1,093,000	$ 1,496,000	$ 51,472,000
RDTE	(35,279,000)	(1,060,000)	(1,496,000)	(37,835,000)
PROCUREMENT	(13,604,000)	(33,000)	(0)	(13,637,000)
BIOLOGICAL RESEARCH PROGRAM	$ 17,727,000	0	0	$ 17,727,000
RDTE	(17,727,000)	(0)	(0)	(17,727,000)
PROCUREMENT	(0)	(0)	(0)	(0)
ORDNANCE PROGRAM	$ 25,647,000	$ 198,000	0	$ 25,845,000
RDTE	(8,120,000)	(0)	(0)	(8,120,000)
PROCUREMENT	(17,527,000)	(198,000)	(0)	(17,725,000)
TOTAL PROGRAM	$ 92,257,000	$ 1,291,000	$ 1,496,000	$ 95,044,000
RDTE	(61,126,000)	(1,060,000)	(1,496,000)	(63,682,000)
PROCUREMENT	(31,131,000)	(231,000)	(0)	(31,362,000)

DEPARTMENT OF THE ARMY

ANNUAL REPORT ON CHEMICAL WARFARE

AND BIOLOGICAL RESEARCH PROGRAMS

(1 JULY 1975 THROUGH 30 SEPTEMBER 1976)

RCS DD-DR&E(SA) 1065

IN CONDUCTING THE RESEARCH DESCRIBED IN THIS REPORT, THE INVESTIGATORS ADHERED TO THE "GUIDE FOR LABORATORY ANIMAL FACILITIES AND CARE" AS PROMULGATED BY THE COMMITTEE ON THE GUIDE FOR LABORATORY ANIMAL RESOURCES, NATIONAL ACADEMY OF SCIENCES - NATIONAL RESEARCH COUNCIL

SECTION 1

OBLIGATION REPORT ON CHEMICAL WARFARE PROGRAM

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

DEPARTMENT OF THE ARMY

RCS DD-DR&E(SA) 1065

OBLIGATION REPORT OF RESEARCH, DEVELOPMENT, TEST
AND EVALUATION FUNDS FOR THE PERIOD
1 JULY 1975 THROUGH 30 SEPTEMBER 1976
REPORTING SERVICE: DEPARTMENT OF THE ARMY
DATE OF REPORT: 30 SEPTEMBER 1976
RCS: DD-DR&E(SA) 1065

	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
CHEMICAL WARFARE PROGRAM	-.022 35.301	32.396 2.883	During the fifteen month period, FY76 and FY7T, the Department of the Army obligated $35,279,000 for general research investigations, development and test of chemical warfare agents, weapons systems, and defensive equipment. Program areas of effort concerned with these obligations were as follows:

Chemical Research:

Basic Research in Life Sciences	$ 940,000
Exploratory Development	6,860,000
Total Chemical Research	$7,800,000

Lethal Chemical Program:

Exploratory Development	$1,709,000
Advanced Development	756,000
Engineering Development	4,543,000
Testing	433,000
Total Lethal Chemical	$7,441,000

Incapacitating Chemical Program:

Exploratory Development	$ 645,000
Total Incapacitating Chemical	645,000

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DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
			Defensive Equipment Program:
			Exploratory Development $11,770,000
			Advanced Development 3,982,000
			Engineering Development 2,344,000
			Testing 860,000
			Total Defensive Equipment $18,956,000
			Simulant Test Support $ 437,000

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DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
1. Chemical Research	-.066 7.806	7.535 .265	
a. Basic Research in Life Sciences	(.000) (.940)	(.885) (.55)	Life Sciences Basic Research in Support of Chemical Materiel: 1. In a study of anticholinesterase effects on mammalian brain stem function the nature of the nerve agent Soman (GD) effects on both inspiration and expiration has been characterized. The dependence of respiratory integrity in the brain stem on conscious or non-anesthetic states has been shown. Specific sites of respiratory blockade by nerve agents were shown. 2. In an investigation of the interrelations among cyclic nucleotides and acetylcholine (ACh) in protected and unprotected animals poisoned with GD, it was found that injection of three doses of dibutyryl adenosine 3,5′ monophosphate (cAMP) and theophylline resulted in a 50% lowering of plasma somanase activity, the enzyme which detoxified GD. Assay procedures were set up for cAMP, cyclic guanosine mononucleotide and ACh. Poisoning of rats with one medium lethal dose of GD causes greater than a 2-fold rise in cerebral ACh. A report entitled "Synthesis of Cholinesterase Following Poisoning with Irreversible Anticholinesterases: Effects of Theophylline-N^6, O^2-Dibutyryl Adenosine 3′, 5-Monophosphate on Synthesis and Survival" was submitted for publication. 3. In order to study the mechanism of spontaneous reactivation of GD-inhibited acetylcholinesterase, it was necessary to develop a model system utilizing acetylcholinesterase inhibited with P-nitrophenyl methylphenylphosphinate to permit an efficient study of perturbing agents on the spontaneous reactivation process. Oral presentation on the above model system was given at the 10th Middle Atlantic Regional Meeting of the American Chemical Society (Feb 76). 4. Studies of sites of action of incapacitating agents in animal brains have shown that anticholinergics injected into dorsomedial thalamus and caudate block pain information and that electrolytic or chemical lesions of central gray matter potentiate morphine analygesia. In preparation of extension of these studies, rat locomotor activity cages were completed.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION

5. In order to classify and predict pharmacological activities of organophosphates and carbamates using pattern recognition techniques, pertinent structure-toxicity data, and pattern recognition analysis for predictive toxicity vectors for carbamates were assembled. Structure-toxicity data, and partial identification of pertinent toxicity features of organophosphates have been assembled. Several computer programs concerning atom-centered fragments and pattern-recognition algorithms were written.

6. The characterization of receptor substance, including mechanisms of reaction with transmitter ligands, and control of permeability of post-synaptic membranes required obtaining radioactively labeled stereospecific ligand for study of muscarinic receptor. Binding activities of stereospecific ligand to those of atropine, scopolamine and quinuclidine benzilate were compared. Investigations of a number of chaotropic agents for solubilization of muscarinic recepter in a biologically active form were completed.

7. Research studies were conducted for new concepts for detection and identification, fundamental aspects of chemical agents research, fundamentals of dissemination and dispersion phenomena, sorbent research, and micellar catalysis for decontamination. Studies on ion-molecule reactions (Ion-Cluster Mass Spectrometry) for detection of chemical agent continued to be promising with the threshold sensitivity for nerve agent sarin (GB) being determined to be 0.002 micrograms per liter of air. Soil micro-organisms which have been grown on thiodiglycol, a hydrolytic product of the blister agent Mustard (HD), have been shown to hydrolyze the thiodiglycol to hydrogen sulfide. This illustration of metabolic pathway is an achievement toward a goal of isolating enzymes for use in detection.

8. Evaporation rates and dynamic behavior of liquid droplets under a variety of conditions have been determined for several chemical agents. A technique compatible with holography has been developed to study aerosol formation from explosive dissemination. As part of an objective of developing quantitative relationships between chemical structure, physicochemical properties and biological activity, correlations were obtained using octanol/water partition coefficients. In a study geared toward providing new detector and analytical reagents a variety of compounds were classed on the basis of the rates at which they produced chemiluminescence.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CYY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
b. General Chemical Investigations	(-.006) / (6.866)	(6.650) / (.210)	Prior year deobligation resulted from the withdrawal of residual funds upon completion of effort.

Exploratory Development effort:

1. Search for New Compounds:

Many new compounds prepared in-house or obtained from outside sources were evaluated as potential agents with possible deterrent application in the areas of binary lethal, incapacitating, and riot control technology and training devices. The results of initial toxicity screening determined the basis for additional studies and whether synthesis of homologs and analogs was warranted. Improved methods for effective screening of compounds are continually sought to predict more reliably and economically the utility of new chemicals. Several hundred combinations have been tested for nerve agent prophylaxis and/or therapy. Clues were developed that lead to the fielding of a second generation treatment and advanced toxicological study of a potentially superior third generation treatment, as well as first generation prophylaxis. Additional compounds are being added to the existing data bank in which the chemical properties and characteristics of all possible chemical agents, intermediates and decomposition products will eventually be stored. Data obtained using a chemical ionization mass spectrophotometric method are being included. This methods allows significantly more positive identification of agents and related compounds, even at the picogram level. The information contained in this data bank is vital to research planning and to intelligence, surveillance, arms control, environmental assessment and forensic determinations.

2. Techniques of Evaluating Effects of Chemicals.

a. Data previously collected from human studies on state dependent learning and vigilance were collated. A determination was made whether to include these in the test battery for future studies. Signal detection tests were initiated to measure the effects of an anticholinergic, and a peripherally acting anticholinesterase compound. It was determined

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

that the anticholinergic significantly altered pain discriminability. To date these tests appear to be the most sensitive animal tests there are to predict drug effects in humans. Attempts will be made to determine whether this same paradigm can be applied to test drug effects on vision. A new test is being evaluated to determine whether it can be used to predict the effects of drugs on frustration in humans.

b. The protocol for standarizing the assay of blood cholinesterase by manual and automated methods for all branches of the Department of Defense was completed. An automated method for the determination of concentrations of physostigmine and pyridostigmine in human blood was developed. Quantitative methods for the complete analysis by extraction, ultraviolet, and gas chromotography of a therapeutic mixture containing three active ingredients were perfected. A method was developed for the assay of an agent simulant in urine in concentrations 1/80th of those previously reported. Studies were initiated on a more sensitive method for measuring triphosphoninositide activity in the brain to determine whether a specific brain site is involved in GB intoxication. Rapid automated methods are being sought to determine the stability of dilute non-aqueous solutions of chemical agents.

3. Medical Effects of Chemical Agents

Improved procedures for assessing the mutagenic properties of chemical compounds have been established. Chlororomazine, considered a possible adjunct in prophylaxis and therapy against nerve agents, was shown to be mutagenic to bacteria. Preliminary data shows that a proposed simulant produced mutagens in the fruit fly. Many selected compounds are being reexamined for mutagenicity. The analgesic properties of cholinergic and of anticholinergic compounds were studied to separate motivation changes from sensory deficits and allow more meaningful predictions of the effects in man. Using localized EEG recordings in somatosensory areas of the thalamus and caudate of rats and monkeys, atropine mimicked morphine in depressing pain evoked activity. Scopolamine and benactyzine also produced analgesia as measured by behavioral tests. Furthermore, atropine and benactyzine disrupted (increased) time perception in the rat. Improved equipment and techniques for electroretinography, visual evoked response research, tear analysis, and cataract formation have been established. Using a differentially radiolabeled glycolate, the distribution, binding, elimination, and metabolic conversion of the compounds is being studied in subprimate brain, peripheral tissues, and body fluids.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

4. Chemical Dissemination and Dispersion Technology.

a. Studies were conducted to investigate and clarify the mechanisms and methods of the delivery, dissemination, and dispersion of agent materials and to conceive and evaluate new concepts of their use. The resulting technology and data base serves as the foundation for assessing our vulnerability to foreign threat and for the development of advanced deterrent systems as well as combat support systems.

b. Equations were developed to describe the instantaneous non-steady state flow during the voiding of bulk liquid fill from spinning cylinders. Successful validation of the equations was obtained for up to 3000 rpm and the evaluation of higher rates, geometries, and fluid properties are in progress. The second phase of this study, developing an analytical description of the resulting droplet size distribution, was undertaken and experimental techniques are being established based on holographic analysis of the aerosol spray.

c. A test program utilizing an explosive test bomblet was concluded and demonstrated that both plant and binary product GB are very resistant to destructive flashing. A methodology was established which showed that the oxygen index of a material, a measure of its flame propogation potential, is part of a basis for estimating the disposition of a liquid to flash when explosively disseminated.

d. Pyrotechnic efforts included (1) determination of critical parameters which would allow the design of much faster burning pyrotechnic mixtures, (2) conduct of curing studies to develop a polymer based pyrotechnic riot control agent (CS) mix, and (3) study of various techniques of utilizing imbiber beads for the purotechnic dissemination of a fog oil smoke.

e. Supported chemical munitions development programs where aerodynamic parameters are involved in delivery and dissemination of the chemicals. Conducted wind tunnel tests for static and dynamic stability; performed trajectory analyses using wind tunnel and flight test data; prepared data which made possible designs changes for improved performance of chemical munitions.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

5. Chemical Testing and Assessment Technology.

a. The need to evaluate and/or predict the operational performance effectiveness of new and improved chemical defensive and deterrent systems requires continuing development of test and assessment procedures, simulation techniques and models, and continuing investigation, development and evaluation of simulant materials.

b. A mixture consisting of triethyl phosphie, dibutyl amine and ethyl acetate has been developed and successully used as a simulant for the XM736 binary nerve agent VX projectile.

c. Toxicological studies on simulants were conducted to obtain information to support requests for approval by the Office of the Surgeon General. Dimethylmorpholinophosphoramidate (DMMPA) was given prime consideration as a intake simulant for casualty assessment and, in combination with a flourescent dye, for use in material contamination assessment.

d. Simulation models were developed to estimate the expected fraction surviving chemical attack when either prophylactic or therapeutic protection or both are provided. Simulation models for chemical agent attack were improved to simultaneously consider both the vapor and liquid particle challenge posed by intermediate volatility agents. Preliminary models to assess the burden of defense equipment (heat stress, performance proficiency reduction) have been developed.

e. A flame photometry device employing sodium chloride was developed to test protective equipment.

f. Improvements were made to the nitrogen purge/air infiltration procedure which was then used to simulate chemical agent vapor infiltration into tanks, armored personnel carriers and self-propelled howitzers.

6. Technical Evaluation of Foreign Chemical Warfare Potential.

a. Support was supplied in the planning, conduct, and evaluation of a series of rocket sled

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION

tests, a fuze check test, and a missile flight test using simulant materials. A preliminary transport and diffusion model was completed, and an evaluation of intelligence information based on the preliminary model performed. Reviews of intelligence information were performed as it became available. Planning coordination of Edgewood Arsenal, MD, Technical Area 12, Chemical Threat Assessment Technology, was also accomplished.

b. Data from the second series of rocket sled tests were reduced which provided an excellent data base for the breakup modeling. The second series differed from the first series in that free flight was achieved prior to warhead detonation, thus providing an environment similar to flight condition. A combination of the breakup model and dissemination model will provide realistic estimates for area coverage, contamination density, and particle size distribution. The initial breakup model addresses only the subsonic region and will be expanded in FY 77 to incorporate transonic and supersonic delivery. The first validation firing was conducted at White Sands Missile Range, NM, in July 1976, using a LANCE Rocket System. The flight test has confirmed the veracity of the data base obtained from the rocket sled tests as the basis for breakup modeling. Preliminary analysis of disposition data also indicates agreement with the limited model presently available.

c. Limited sampling data were collected during the White Sands Missile Range tests of the LITTLE JOHN and LANCE rocket systems that contained simulants. The data indicated that from a liquid agent detector point of view, there may be some significant differences in data obtained from dynamic rocket tests as compared to static spray trials. Attempts to obtain spread factor data for a simulant during the rocket sled tests were unsuccessful. Efforts are still continuing in devising a simple, reliable generator for simulants.

7. Chemical Training Agents and Equipment Investigations.

a. Investigations are underway to develop materials which resemble chemical agents in their employment, dissemination, action, and sensitivy to alarm systems, but which leave no harmful effects on troops, their equipment, or the environment. A statement of work in response to a

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training device requirement has set forth numerous criteria for simulated persistent and non-persistent agents required by the user. While several prospective candidates were found to meet many of the needs, no completely satisfactory material has yet been discovered, so attempts must continue to find appropriate chemicals or formulations.

b. Various thickeners are being investigated for the formulation of thickened chemical training agents. In order to field a training device that possesses an operational capability, the Simulant Projector Airburst Liquid has been evaluated using training agents previously approved. The US will require this item as an interim training device. The interim training agents being studied for use in this disseminator are polyethylene glycol 200, tri-(2-ethylhexyl) phosphate, and butyl mercaptan.

c. Summary data on dimethyl methylphosphonate obtained from allies on the irritancy, pharmacology, and chronic toxicity (rabbits and rats) failed to meet US criteria for starting human trials with the compound. A biomedical evaluation by the Medical Review Board gave proposed data voids from which a research plan on the toxicology in four animals was derived. Laboratory quantities of dimethyl methylphosphonate were synthesized and characterized by Nuclear Magnetic Resonance, Mass Spectroscopy, Gas Chromatograph and Infrared and found to contain at least two impurities. Initial acute toxicity studies in mice and rats via parenteral and oral routes with these samples are underway. Studies on mutagenesis using fruit flies and the Ames test employing Salmonella typhimurium were completed. Acute toxicity studies on bioassay approved pilot plant synthesized dimethyl methylphosphonate were initiated.

8. Chemical Safety Investigations.

a. A report has been prepared describing the collection and purification of samples for agent identification. A method for high volume sampling compatible with gas chromatography analyses was developed. Gas chromatography has been coupled with chemical ionization mass spectrography to furnish a method of detecting and identifying GB and VX in demilitarization products at very low levels. The high volume sampling and chemical ionization mass spectrography will be developed further.

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			b. Ecological field work on Carroll Island at Edgewood Arsenal, MD, has been completed and initial drafting of the comprehensive report covering this work has been started. Ecological investigations of Gunpowder Neck at Edgewood Arsenal, MD, are in progress and will continue. c. Two remote sampling systems to be used with controlled toxic test chambers have been designed and one is undergoing evaluation. An automated analytical system is in use and will be interfaced with the sampling system.
2. Lethal Chemical Program	.091 7.441	7.166 .275	Exploratory Development Effort:
a. Agent Investigations & Weapons Concepts	(.080) (1.629)	(1.709) (.000)	1. Lethal Chemical Agent Investigations a. Synthetic, analytical, and physicochemical studies of toxic chemicals were performed to assess the lethal agent threat from a possible enemy. A new procedure has been developed for the binary synthesis of a lethal agent of intermediate volatility. A method to reduce the reaction rate of binary agent intermediates has been developed. Two methods have developed for the in situ thickening of a persistent lethal agent obtained from a binary process. b. Evaluations of methodology and procedures to deliver small sized drops of agent while maintaining a low temperature and high wind speed environment have continued. Some difficulty was experienced in delivery of small drops of simulated agent. Recalibration of the environmental animal exposure facility to attain controlled temperatures (75 degrees, 40 degrees, and 20 degrees F) and wind speeds (1.1 and 5.5 mph) is being completed in preparation for the evaluation of comparative effectiveness of thickened and non-thickened agents. 2. Lethal Chemical Weapons Technology. a. Success was achieved on techniques for binary production of an intermediate volatility agent, with limited work conducted on a number of the practical facets of synthesis. Studies of the reaction of stored intermediates was continued and expanded to ascertain the ultimate effects of intermediate degradation on product yield. Studies of agent physical properties and their effects on the efficiency of munition dissemination were conducted. Work in this area

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has been very successful in that physical properties can be modified easily without subsequent interference in reactions or any reduction in product yields. Property modification studies have required dual agent-simulant development, since only the latter can be tested in a number of the conditions of interest.

b. Projectile exploratory efforts included experiments to ascertain whether wide variations in internal reactions influence projectile ballistic performance (they do not) and whether mechanical resonances are generated which could influence fuze performance (they are). The study was expanded to include liquid filled flight performance of both long and short range fin stabilized projectiles. Technique for increasing the efficiency of chemical dissemination was evaluated.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
			c. Experimental designs for a 2.75 inch rocket warhead were developed. This effort included derivation of analytical models for the warheads effectiveness based upon experimental efforts. Testing included rocket firings and dynamic flight evaluation. 3. Chemical Agent Process Technology. Investigation of processes for the synthesis of binary reactants were continued and small quantities of material prepared for test by others. Two processes for synthesis of dimethyl disulphide intermediate were studied at the laboratory and bench scale and parametric data obtained to facilitate a selection of one process for pilot scale development. Analytical support was provided for the above activity of the development and synthesis laboratories.
b. Agent Pilot Plant Investigations	(-.005) / (.311)	(.306) / (.000)	Prior Year deobligation resulted from withdrawal of residual funds upon completion of effort. Advanced Development effort: 1. Lethal Chemical Agent Processes. a. Batches of one of the binary intermediates was made to obtain pilot plant data for scale up. Commercial sources of required chemicals were used. Process studies of alternate methods were contained to obtain data for the economic analysis for the best process for plant scale up. Alternate process studies of sub-pilot scale size to reduce the large quantities of aqueous waste solutions have been initiated. The waste materials from these studies have been collected to begin studies on waste disposal methods. b. A filling and closing line design is currently in progress and was 50 percent completed during this period. A total of 180 canisters were filled and closed in support of the engineering development phase of this program. The modular filling and close capability, was used. All equipment functioned well, there were no leakers. A decision was made to use stamping for the inertia welded closure plug. This should eliminate the leakage problem caused by porosity found in the plugs cut from round stock.

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c. Tactical Weapon Systems	(.000) (.450)	(.245) (.205)	Advanced Development effort: Lethal Chemical Materiel. Efforts were initiated in the latter portion of FY 76 on technology areas relevant to development of a warhead for rocket systems. Contractual effort was begun on problems of large scale fluid mechanics, multiple sub-systems and system logistics. Provisions were made for a large scale dynamic simulant test of a rocket warhead concept.
	(.016) (4.527)	(4.473) (.070)	Engineering Development effort: Lethal Chemical Ground Munitions. a. The Development Test II (DTII) of the 155mm, XM687E1, GB2 projectile was satisfactorily completed and a detailed report covering this phase issued. Similarly, Operational Test II (OT II) has been completed. This latter involved troop tests to evaluate the adequacy of the projectile in use. The technical data package and reports documentation of the XM687E1 projectile were completed. b. Engineer design testing of the 8 inch, XM736, VX projectile was successfully completed and manufacture of hardware for DTII initiated. In the course of the former, various facets of structural integrity, operational performance, and ballistic performance were successfully demonstrated.
d. Materiel Tests in Support of Joint Operational Plans and/or Service Requirement	(.000) (.000)	(.000) (.000)	No effort expended in this area.
e. Army Materiel Development Tests	(.000) (.433)	(.433) (.000)	Efforts were directed toward the testing of binary weapon systems. Twelve specific test programs were conducted. Major emphasis was on the completion of the DTII testing of the 155mm, XM687, projectile. Physical testing in the area of rough handling, safety, reliability, suitability of the projectile, and ballistics were completed. Twelve simulant dissemination

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			trials were conducted. A final report for DT II testing of the 155mm, XM687, projectile was published. Engineering design test with the 8-inch projectile were conducted in the area of reliability; safety evaluation of the rounds for transportation, storage, rough handling, and firing; determination of the suitability of the projectile for DT II testing; and ballistic stability. Simulant dissemination trials with the 8-inch projectile were conducted and data on area coverage, droplet spectra, and liquid recovery estimates were obtained. The most applicable simulant for support of the DT II test will be selected from the candidates tested. Planning for the DT II testing is in progress. Test efforts with the 8-inch projectile will continue in fiscal year 1977.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION .
3. Incapacitating Chemical Program	.000 .645	.645 .000	
a. Agent Investigations & Weapon Concepts	(.000) (.645)	(.645) (.000)	Exploratory Development effort:

1. Incapacitating Chemical Agent Investigations:

Studies were carried out to devise a reaction suitable for producing a candidate incapacitant by a binary process. Although at least three separate approaches seemed promising initially, extensive investigations have failed to provide a feasible solution to this difficult technical problem. Techniques for studying the evaporation kinetics of combinations of selected liquid and semi-solid incapacitants were reviewed. Work was conducted to develop analytical methods for identifying incapacitants in trace amounts: one of the these used a thin layer chromatography technique, where the base values of candidates were determined relative to two reference dyes. Another analytical technique, previously developed for identification of promising incapacitants in work areas such as a manufacturing plant, was refined to give more accurate results. Analytical and physiochemical studies were performed to characterize incapacitants, their precursors, intermediates and side-products. The scientific literature was reviewed for new leads on safe, effective incapacitants. No promising leads were discovered.

2. Incapacitating Chemical Weapons Technology.

Available data on pyrotechnic incapacitating munitions has been reviewed with no solutions available to solve the safety problem of agent release during an accident. The binary agent approach is being adopted to solve this problem. A literature search has been conducted on lethal binary concepts to determine applicability to incapacitating munition design. The two compartment thermal generation principal is the most promising dissemination method available. Laboratory space has been obtained and equipment is being modified to perform laboratory studies on binary reaction conditions required prior to design of test munitions.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
4. Defense Equipment Program	-.107 19.063	1 .621 2.335	Prior year deobligation resulted from withdrawal of residual funds upon completion of effort.
			Exploratory Development effort:
a. Physical Protection Investigations	(-.018) (5.776)	(4.525) (1.233)	1. Chemical Agent Alarm Technology:

a. Exploratory development continued on the Advanced Ionization Detector in an effort to determine the optimum design for highest sensitivity and selectivity. Extensive testing was conducted to uncover possible interferences which trigger an alarm or cause serious deterioration of the detector. Field trips were made to Fort Benning, GA, Tropic Test Center, Panama, Rocky Mountain Arsenal, CO, Fort Carson, CO, and to Nellis Air Force Base, NV, where environmental tests were run with the prototype units in conjunction with all types of troop field exercises. A contract with Southern Research Institute calls for examination of many chemicals to determine laboratory type interferences. This contractor has made field trips to Smoky Mountain National Park and throughout the state of Florida, especially the Everglades, seeking more environmental type interferences. Results were favorable. A satisfactory immobilized enzyme product for use in the Enzyme Alarm was achieved through chemically bonding cholinesterase to the surface of urethane foam. An interference compensating circuit, using a fourth electrode was developed and results have been very promising. The fabrication of three new Enzyme Alarm units employing the latest technology was initiated. Based upon the results of studies on the mechanism of detection, improvements were made in the sensitivity and stability of Automatic Liquid Agent Detector (ALAD) paint. An operational effectiveness study based on a user scenario was conducted with results indicating significant casualty reduction associated with the use of the ALAD at the platoon level. Special instrumentation was designed and is being fabricated for two field trials.

b. A special eight wavelength CO_2 laser system was built and subjected to initial testing. Computer techniques for modeling the laser system response were developed. Based upon the results of an in-house theoretical study and consultations with outside experts, an effort is underway to investigate heterodyne detection techniques using the CO_2 laser. This technique should give a large increase in sensitivity. Studies were terminated on use of the

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the Remote Raman for airborne agent detection. The system's sensitivity, size and complexity did not appear competitive with the CO_2 laser device. However, studies continued on the Raman concept for monitoring for the laser system and a new more powerful Nitrogen laser was also purchased. The system's sensitivity increased as a result. Unfortunately flourescence background stimulated by the system increased also. An argon laser was substituted for the nitrogen laser. Spectra obtained by the system have improved substantially. The system has been used to measure relative cross sections for the GB simulant diisopropylmethylphosphonate.

c. A chemically coated Lucite plug was shown to be a simple, feasible method for detecting leaks within a VX munition. The coating changes color in the presence of VX vapor or its decomposition products. Limited long-term storage tests indicate that the coating is stable.

2. Chemical Detection and Identification Technology

a. A 3-year contract was signed with Midwest Research Institute to study eel cholinesterase as a potential improved nerve agent detector and develop a test for refractory nerve agents. A 1-year feasibility contract was awarded to Midwest Research Institute to study metnods of detecting agents in water using standard detector tubes. Findings of current in-house investigations in all the above areas are being supplied to the contractor. Calspan Corporation completed a search of methods applicable to a non-specific agent detector kit. They are presently evaluating the simplification of the Ionization Detector as a possible app oach.

b. Significant increase in detection and identification capability has resulted from the improvement of the sensitivity and specificity of the Ion Cluster Mass Spectrometer System (ICMS) and Field Ionization Mass Spectrometry. Research on the ICMS has demonstrated sensitivity of less than 0.1 parts per billion of GB. New highly reactive cyclic thioureas were discovered detecting alkylating agents and phosphorylating agents by chromogenic, fluorogenic or nephelometric responses. A new ketooxime, has been synthesized which showed promise as a reagent in the M8 chemical agent alarm, possible enhancing the capability of the alarm. Soil organisms have been cultured on chemical agent mustard hydrolysis products having enzymes capable of degrading the substrate to hydrogen sulfide and acidic materials. New ultrafine impregnated microporous membranes for use in a high volume sampling system have been prepared capable of selectively concentrating phosphorous esters from the atmosphere.

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3. Chemical Decontamination Investigations;

a. Work on the polyvinyl alcohol (PVA) supplemental coating to prevent toxic agents from sorbing into agent permeable materials was held in abeyance after numerous unresolved application, adhesion, and weathering problems became evident. Multiple applications are required for adequate film thickness; film drying time is excessively slow; the sheen (gloss) of the film cannot be reduced to a level acceptable for camouflage purposes; although the PVA is not cold water soluble, it is softened sufficiently by rain water to be easily damaged; the adhesion is only marginal; and the film deteriorates with extended outdoor weathering. The feasibility of developing a man-portable spray apparatus for dispersing the standard decontaminating agent DS2, and having sufficient capacity to effectively decontaminate the largest tactical equipment and vehicles, was shown possible by modification of commercially available spray equipment and the program moved into advanced development in Feb 76. After successful application trials at Ft Carson, CO, the agent resistant urethane paint was determined by the US Army Materiel Development and Readiness Command Surgeon to contain small quantities of a skin, eye, and respiratory irritant. It was dropped from the Camouflage Pattern Program in which the paint is sprayed by troops at company level. As a result of this decision, the following approaches were undertaken: a. By means of a research and development contract the state-of-the-art was surveyed for innocuous polymeric systems with potential for agent resistance. Four candidate coatings are now being evaluated for resistance to agent sorption: b. US Army Mobility, Equipment, Research and Development Command (MERADCOM) was tasked to reformulate the agent resistance urethane into eleven camouflage colors with brush application capability. Brush application presents less hazard and requires less restrictive application precautions. Reformulation is near completion; c. MERADCOM was tasked to prepare various alkyd paints and painted panels to determine the effect on agent sorption properties of resin modification, thermal curing, and natural and accelerated weathering. The panel preparations are now complete. Long term natural weathering and agent sorption tests are in progress. To speed up the evaluation of the agent sorptive properties of various materials and the effectiveness of different decontaminants, newly available automatic agent detection equipment has been evaluated and an advanced gas chromatograph ordered. A one year contract for the development of a

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design criteria document to assist design agencies in the development of new equipment so as to minimize liquid agent contamination and/or maximize physical decontamination has been awarded. In-house and contract studies were initiated and are in progress to obtain sufficient data to increase the cost effectiveness ratio of a proposed decontamination kit for exposed skin and personal equipment to replace the present standard M13 and M258 chemical agent detector kits. Increased cost effectiveness is required for approval of the proposed Letter of Agreement on this item.

b. In the search for decontaminants for removal and destruction of toxic agents on vehicles, equipment and materiel, utilizing readily available materials in the field such as water, oxygen of the air and/or moisture, a number of micelle forming N-long chain alkyl pyridinium aldoximes were synthesized and evaluated against nerve agents GB and VX. Sulfur and nitrogen containing model compounds for sulfur mustard and VX were investigated as to their photosensitized oxidations by sunlight and oxygen in the air. The photooxidations of dibutylsulfide and diisopropylethylamine in methanol in the presence of the photosensitizer Rose Bengal were shown to proceed at moderately fast rates, depending upon light intensity, simple geometry and sensitizer concentration. Both reactions were zero order. Thus, fast rates are favored by dilute substrate in thin films. It has also been found that sensitizers covalently bound to polymers can be used for photooxidation of mustard. Moreover, photobleaching of the sensitizer is less when the sensitizer is affixed to a polymer matrix.

4. Physical Protection Against Chemical Agents;

a. Emphasis was directed toward the development of non-destructive methods of measuring the residual gas life (protective capacity) of charcoal filters. Various techniques, such as: 1) the use of pilot canisters in parallel with the large filters, 2) CO/CO_2 techniques, 3) sampling from within the charcoal bed, and 4) electrical methods, were selected for further investigation. Baseline testing and simultaneous exposure of pilot canisters is in progress to determine the validity of this approach. Conversion of CO to CO_2 for measuring residual

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blood agent cyanogen chloride (CK) life indicates impregnant activity but not residual sorption capacity. Modification of this approach to provide this capability is in progress. Use of a probe in the bed to locate adsorption front for a test gas after unknown exposure is being actively investigated. Electrical methods of using semiconductor sensors and electromagnetic wave adsorption are also being investigated.

b. Development efforts have centered on finding an elastomer to replace silicone as the protective mask facepiece material. Polyurethanes thus far offer the most likely successful candidate materials. Several experimental polyurethanes have been investigated and efforts are being made to improve those areas of physical characteristics that are deficient. A contract is being negotiated to conduct a survey of commercially available elastomer falling within the range of required physical, chemical, and optical characteristics. The contract completion date is six months, at which time leading candidate material will be selected for further development.

c. Components of synthetic sweat which cause the greatest loss in sorptive capacity of activated charcoal were identified. Treatments for activated charcoal which will reduce the effects of poisoning by sweat were briefly examined. The materials are of a type which impart water repellancy to the charcoal without seriously affecting carbon tetrachloride adsorption. The penetration of GD through combat and protective clothing systems was measured. These studies were performed to collect agent vapor penetration data for a base line to be used during the development of new protective clothing systems. A contract request was released to investigate methods of producing fabrics containing sufficient chemical agent neutralizing activity to permit their use in protective clothing. Coordination with the US Army Natick Research and Development Command was continued in an endeavor to develop an integrated plan for the development of chemical protective clothing.

d. In efforts aimed at increasing our ability to predict gas adsorption by activated carbon beds under dynamic flow conditions special emphasis was given to the study of dimethyl methylphosphonate (DMMP) adsorption as a function of flow velocity. For the case of pure physical adsorption, such as with DMMP, it was found that the adsorption rate constant varied non-linearly with the superficial linear flow velocity over the range of 2-60 cm sec^{-1}. A mathematical model for the relation between adsorption rate and velocity indicated that a diffusion controlling step was dominant up to a velocity of 50 cm sec^{-1}. A study of whetlerite

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			carbon reactivity against CK has shown that subsequent to initial adsorption of CK by the carbon, chemical destruction of the CK occurs via a 2-step catalytic hydrolysis, producing carbon dioxide and ammonia.
b. Advanced Development of Defensive Systems	(-.033) (4.015)	(3.744) (.238)	Deobligation of prior year funds for reprogramming to provide program continuity to the Binary program pending Congressional release of current year funds.
			Advanced Development effort:
			1. Remote Sensing Alarm;
			In-house efforts were devoted to preparing for comparison tests against the Navy Forward Looking Infrared Detector. This included field tests, repairing the exploratory development hardware and data processing. Immediately prior to the scheduled date for comparison tests at Dugway Proving Ground. The Department of Defense postponed the tests indefinitely as a result of Congressional action.
			2. New Protective Mask;
			The New Protective Mask will enter Engineering Development in Mar 77. A unique transparent silicone rubber has been developed which provides optical clarity, flexibility across the required environmental temperatures, and low compression set characteristics. The use of this material permits the molding of the facepiece and lens as a single part and, therefore, the largest possible visual area is provided. The flexibility of the lens permits it to be utilized with optical instruments without significant loss in field of vision. The outsert for the mask is available in a flexible version for field use and a rigid version which provides ballistic protection for the tank and aircrew applications. The canister of the mask can be utilized on the facepiece or attached to a transitional hose which allows the canister to be mounted in a carrier. The configuration of the New Protective Mask has been firmly established and the sizing has been so adjusted that the military population, including females, can be accommodated in three sizes. A highly unique design of nosecup provides comfort and extends the range of face sizes which can be accomodated. The design of molds and other tools to fabricate the New Protective Mask has been initiated, and fully molded prototypes will be available for the

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Advanced Development testing which will precede entry into Engineering Development. Processes for coating the molded facepiece with a flourinated ethylene propylene rubber and polyurethane material have been developed. Irradiation of the facepiece with high speed electrons is accomplished to increase the hardness in the lens region, to decrease compression set and to eliminate crazing at the interface of the coatings and the facepiece. Permeability tests have been conducted on coated facepieces which indicate that the minimum NATO requirements for permeability can be met. The canister of the New Protective Mask has been subjected to penetration, rough handling, and environmental use testing. The canister appears capable of meeting the requirement for 10 years of storage followed by one year of operational use under temperate conditions. Requirements for ease of filter change, etc., have been met. The design of spectacles/inserts and the protective hood have not been finalized. Tests under arctic and tropical conditions using early prototypes indicate that the mask should meet the joint requirements established.

3. Decontamination Apparatus for Vehicles.

Advanced Development (AD) was started in Feb 76 using information generated earlier. Because of the short development schedule required by the Proposed Letter of Agreement (PLOA), commercially available spray apparatus will be modified to meet the requirements of the PLOA and development will proceed directly from Advanced Development to Type Classification. Various types of spray apparatus were obtained from different manufacturers and evaluated for performance characteristics using decontamination agent DS2 simulant where possible. Among the pump types evaluated, the trombone type is superior, as is the stainless steel container. Evaluation of the various materials used in the construction of the spray apparatus for long term compatibility with DS2 at ambient and elevated temperatures is in progress. A Configuration Control Board has been established for this item and a Proposed Development Plan and an Initial Draft System Specification were drafted. A Secretarial Determination and Findings and backup Procurement Plan for the Advanced Development contract have been forwarded for approval. The Scope of Work for the Advanced Development contract was prepared. Purchase requests to obtain specially modified commercial spray equipment and drawings from two manufacturers have been processed.

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c. Collective Protection Systems	(-.001) (.521)	(.307) (.213)	Prior year deobligation resulted from the withdrawal of residual funds following completion of effort. Engineering Development effort: Modular Collective Protection Equipment (MCPE): MCPE consisting of Filter Units, Gas-Particulate XM56 (200 cfm), XM59 (400 cfm), and XM62 (600 cfm) together with the Entrance, Protective, XM10 satisfactorily completed basic DT II/OT II tests. Environmental testing (Arctic, Tropic, and Desert) will be completed by December 1976. M56 Filter Unit and M10 Protective Entrance were type classified for TACFIRE use in March 1976. Work continues on MCPE applications to AN/TSQ-73, Improved HAWK and Patriot (SAM-D).
d. Warning and Detection Equipment	(-.055) (1.879)	(1.305) (.519)	Deobligation of prior year funds for reprogramming to provide program continuity to the Binary program pending Congressional release of current year funds. Engineering Development effort: 1. Chemical Agent Detector Kit, XM256. Engineering design testing was completed and hardware was made for product qualification testing. Tests were completed satisfactorily and items were fabricated for OT II/DT II. These tests were begun. 2. Paper, Chemical Agent Detector, XM9. The engineering design and long term storage tests on the XM9 were successfully completed. Tests at US Army Training and Doctrine Combined Arms Test Agency, Ft Hood, TX, established that the XM9 was not sufficiently durable when used on vehicles in a combat environment and found that false positive responses were obtained with LSA (Lubricant Small Arms). Systems Analysis studies on the usefulness of the item have been completed as well as work to determine the optimum location for wearing the item. An alternate method for making R-1 dye has been found. Investigations have been initiated on developing a laboratory generator for dispensing small droplets. Dugway Proving Ground, UT, has initiated methodology studies for testing the XM9.

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e. Medical Defense Against Chemical Agents	(.000) (6.012)	(5.880) (.132)	Exploratory Development effort: 1. Various vaccines proposed for nerve agent intoxication prophylaxis have been prepared and tested. An enzymatic slide test has been developed. A nerve agent antidote (TAB) has been fielded. New efforts have been initiated to provide an expanded data base for TAB to support Food and Drug Administration (FDA) requirements. These include detailed metabolism and drug distribution investigations. An improved therapy has been tested extensively in lower animal species and appears to warrant concerted effort as a future replacement for TAB. A first generation prophylaxis has been chosen and is awaiting approval by the Army Surgeon General and FDA for human testing. Stability of drugs now proposed was investigated in detail. Behavioral evaluation of current and proposed drugs were made. Methods for administration of cromolyn sodium, a mast cell stabilizer, were investigated as a first step in using this drug in pre- and post phosogene intoxication in rats. 2. The vesicant and incapacitating effects of mustard agent (HD) are being studied with a special view toward establishing a rationale for their therapy and/or prevention. Studies on developing a pathogenic sequence from initial damage to deoxyribonucleic acid of basal cells to the occurrence of inflammation, edema and vesication continues. An animal model for vesication employing hairless mice and a quantitative measurement of edema formation following exposure to HD will be used. The efficacy of a number of selected antiinflammatory compounds in moderating skin damage produced by HD is being explored. The action of anticholinergic compounds (glycolates, benactyzine, atropine) can be successfully reversed by cholinergic agonist such as physostigmine. Dose-response curves of this therapeutic effect have been generated for a model system - the physostigmine reversal of benactyzine-induced somatosensory deficits. This cholinergic carbamate also significantly elevated pain threshold at the optimum therapeutic dose but produced analgesia at higher doses. Behavioral evaluations of the side effects of physostigmine will continue. These include evaluating the effects of this therapy compound on learning, memory, emotions, and sensory systems. In addition, time course studies on the duration of its therapeutic effects were conducted. 3. A rabbit ear bioassay was developed for thickened agents, decontaminants and barrier materials. Bioanalysis of M258 decontaminating kits showed poor cleaning of widely dispersed thickened nerve agent GD by kit scrapers of alcohol/water solvents. Therefore, acetone was

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substituted for alcohol in the M258 kit solution I to result in significantly better cleaning and decontamination. Methyl and phenyl cellosolve show promise as alternate solvents, especially for prophlyactic applications. The phase diaphragm concept was used to select alternate thickeners, decontaminant solvents, and agent additives. Contractor furnished lipophilic oximes and hydroxamic acids, barrier materials, and a histologic assay for irritants and protectives. Effectiveness of barrier film containing fluoropolymer was demonstrated. Protocols were written for submission to the Office of The Surgeon General for study of the reservoir function of skin for possible use in protection, prophylaxis and therapy of anticholinesterases.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
f. Materiel Tests in Support of Joint Operational Plan	(.000) (.284)	(.284) (.000)	Efforts were directed toward the field testing of the following: 1. US Air Force Chemical/Biological (CB) Modification Kit, Structure - KMU 450/F: Test was designed to determine the adequacy and reliability of the CB Modification Kit system to provide protection against penetration of CB agents. For this period tests in the area of chemical and biological challenge, exit/entry procedures using biological simulants, and pressure studies were conducted. Final reports covering all aspects of the test have been published. 2. Long Path Infrared Chemical Detector (LOPAIR)/Foward Looking Infrared Chemical Detector (FLIR)Comparison Test: Test was designed to obtain field test data required for a comparative evaluation of the LOPAIR and FLIR detection systems in a realistic harassing and interdiction for field situation. For this period a test plan and environmental impact assessment (EIA) were developed, coordinated with Army/Navy proponents and published for the LOPAIR/FLIR comparison test. Laboratory investigations to validate sampling and chemical analysis methods for two simulants co-dispersed with various interferents were completed. Preparation of the Dugway Proving Ground, UT, test site, munition modifications and preparation of an EIA for the Navy test site were in various stages of completion when the test program was suspended. 3. Decontamination Capabilities of Chemical Units and Teams: This test was designed to study the capabilities of US Forces to decontaminate equipment which had been subjected to a thickened chemical agent attack, to determine any measures which might be adopted to improve these capabilities, and to determine the relative effectiveness of standard decontamination procedures on specific agent simulants and to establish a standard baseline time required for effective decontamination of standard Army equipment. Test has been completed. For this period, twenty six simulant field trials to obtain data for a time and motion analysis was completed. Fifteen field trials with a chemical simulant to evaluate comparative decontamination procedures were conducted. Forty-three laboratory investigation tests to estimate the comparative effectiveness of selected decontamination solutions against four different surfaces contaminated with several agents was completed.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
g. Army Materiel Development Tests	(.000) (.576)	(.576) (.000)	Tests were conducted on the US Army's defensive equipment and materiel and in the long term environmental storage and surveillance testing. Test efforts were as follows:

1. Modular Collective Protection Equipment (MCPE): This test effort was designed to perform a DT II test and to determine the capability of the MCPE to meet system specification requirement. Agent and simulant challenge tests were conducted. A final report was published.

2. Protective Overgarment Suit: Test is designed to obtain comparative data on each of the three chemical protective suits with regard to the level of protection afforded after specified intervals of wear, durability, and the degree to which suits meet the essential characteristics of the US revised military and technical characteristics. Testing in the area of protective capabilities of new, worn, and stored garments, effects of salt water and fresh water immersion, suit of capabilities for spot emergency decontamination, flame resistant capabilities, storage effects, and air permeability was accomplished. A final report was published.

3. Chemical/Biological Test for the Stinger Guided [illegible]sile System: Test is designed to determine if system components can be successfully deco[illegible]inated without damage to the system. During this period testing was initiated. Test is sch[illegible]led for completion in FY77.

4. Chemical Agent Detector Kit, XM256: This test effort is designed to perform a DT II test and to determine: 1) the technical performance; 2) safety of the items; 3) its maintenance test support package; 4) demonstrate whether engineering is reasonably complete; and 5) effects of extreme climatic environments. During this period planning was accomplished and testing was initiated.

Reports will be published in FY77.

5. Chemical Agent Detector Paper XM9: This test is designed to determine if the XM9 meets the design requirements, performance standards, and technical characteristics of the requirement, effects of extreme climatic environments on the item, and whether engineering is reasonably complete. For this period, a draft test plan has been prepared and laboratory technology was initiated to determine sensitivity test methods for extreme temperature ranges. Test will be completed 1st quarter FY78.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

6. Chemical/Biological/Radiological Vulnerability for Ground Launched Laser Designator: This test effort is designed to determine if system components can be successfully decontaminated without damage to the system. During this period planning was accomplished. Testing is to be initiated in FY77.

7. Battery Computer System: Test is designed to determine if system components can be successfully decontaminated after Chemical/Biological contamination without damage to the system. Initial planning has been accomplished. Testing is scheduled for FY 78.

8. Digital Message Device: This test is designed to determine if system components can be decontaminated without damage to the system. For this period all necessary planning has been accomplished. Test is scheduled for FY 77.

9. Decontamination Vehicle: Test was designed to determine the feasibility of decontaminating military equipment using a new decontamination vehicle concept. For this period a variety of panels were contaminated using chemical agents and then decontaminated. Testing was completed and a final report published.

10. 155mm Cannon Launched Guided Projectile, XM712: Test is designed to determine if system components can be successfully decontaminated without damage to the system. For this period a test plan was prepared, coordinated, and published. Test is scheduled for conduct in FY 78.

11. DT II of Common Thermal Night Sight: Test is designed to determine if system components can be successfully decontaminated without damage to the system. For the period a test plan was prepared, coordinated, and published. Test is scheduled for conduct in FY 77.

12. Environmental Surveillance: The long term environmental storage and surveillance program had a total of five items undergoing some phase of testing at one or more of the test sites. Items consisted of masks, chemical detectors, and chemical alarm units.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
5. Simulant Test Support.	.000 .437	.429 .008	
a. Materiel Tests in Support of Joint Operations Plans and/or Service Requirements	(.000) (.437)	(.429) (.008)	Efforts were directed toward the planning, conducting, and/or reporting of the following joint operational tests and operations research studies: 1. Evaluation of Delivery and Assessment Techniques: This test, consisted of four subtests, is in response to Army, Navy, and Air Force requirements and is concerned with evaluation of delivery and assessment techniques for simulant spray systems. Testing was completed in fiscal year 1974. For this period, data analysis was completed and the final reports covering all aspects of the test program were published. 2. Hazards Evaluation: This test is a research effort with the aim of duplicating the contamination pattern of a massive chemical attack with the use of simulants and correlating simulant/agent data to permit hazard and vulnerability analyses. For this period, data analysis has been completed and a final report has been published. 3. Evaluation of Marine Vehicle to Massive Chemical Attack: The US Marine Corps requested a test to evaluate the effective use of the a landing vehicle when subjected to a simulated massive chemical attack. Data analysis has been completed and final report has been published. 4. Vulnerability of Marine Wing Weapons Unit: This test, in response to a US Marine Corps requirement, involves a Marine Wing Weapons Unit performing mission tasks with a nuclear trainer in a simulated toxic environment. The test is designed to evaluate minimum performance degradation caused by a massive chemical attack. For this period, data analysis was completed and a final report was published. 5. Integrity of Spray Tanks and Hazards to Personnel: This operations research study is in response to a US Marine Corps request which will evaluate the effects of chemical agents and decontaminates on the continued integrity of spray tanks and estimates of hazards associated with recycling or decontaminating the tanks. For this period, the study was finalized and published.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) FY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

6. Thickened Agent Survey: This study will review all past and current data on thickened chemical agents. For this period, a literature survey of data has been accomplished. Study will be completed in FY 77.

7. Thickened Agent Investigation: This effort is a combination study and test. A study will be performed to determine the relationship of ground contamination to the impaction and distribution on man for thickened materials. The test is designed to obtain data on the dissemination characteristics of bursting munitions filled with thickened simulant and to estimated dose-casualty relationships for such munitions. During this report period, the study has been initiated. A literature survey of all data has been accomplished. Test plan was prepared, coordinated, and published. Testing was initiated. Test completion is scheduled for FY 77.

8. Agent Transfer Factors: This test is designed to provide data on the transfer factor and pickup associated with the field employment of vehicles, and equipment when exposed to thickened agent simulants. During this period, a test plan was prepared, coordinated, and published. Testing was initiated. Test is scheduled for completion FY 77.

OBLIGATION REPORT OF PROCUREMENT FUNDS
FOR THE PERIOD 1 JUL 75 THROUGH 30 SEP 76
REPORTING SERVICE: DEPARTMENT OF THE ARMY
DATE OF REPO. .: 30 SEP 76
RCS DD-DR&E(SA) 1065

	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
CHEMICAL WARFARE PROGRAM	1.679 11.927	3.878 9.726	During the fiscal year 1976, the Department of the Army obligated $13,604,000 for procurement activities associated with chemical warfare agents, weapons systems, defensive equipment, and production base projects. Program areas of effort concerned with these obligations were as follows:

Lethal Chemical Program

Materiel Procurement	$ 0
Production Base Projects	7,540,000
TOTAL Lethal Chemical	$7,540,000

Incapacitating Chemical Program

Materiel Procurement	$ 0
Production Base Projects	0
TOTAL Incapacitating Chemical	$ 0

Defensive Equipment Program

Materiel Procurement	$5,040,000
Production Base Projects	1,024,000
TOTAL Defense Equipment	$6,064,000

DESCRIPTION OF PROCUREMENT EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
. Lethal Chemical Program	.050 7.490	1.214 6.326	
a. Item Procurements	(000) (000)	(000) (000)	No obligations were incurred for procurement of lethal chemical end items.
b. Production Base Projects			
Chemical Agent and Munitions Disposal System	(000) (7.490)	(1.164) (6.326)	Obligations incurred to purchase equipment for a multipurpose disposal system for use in detoxifying and/or disposing of obsolete/unserviceable chemical munitions and toxic agents. Ultimate system will consist of a series of modules which can be transported to sites containing obsolete/unserviceable toxic agents/munitions, assembled and operated to detoxify and dispose of material.
155mm Binary Projectile, XM637	(.050) (000)	(.050) (000)	Engineering and design in support of establishment of a chemical production load, assemble, and pack facility for 155mm Binary Projectile, XM637.
2. Incapacitating Chemical Program	(000) (000)	(000) (000)	
a. Item Procurements	(000) (000)	(000) (000)	No obligations were incurred for procurement of incapacitating chemical items.
b. Production Base Projects	(000) (000)	(000) (000)	No obligations were incurred for production base projects in support of incapacitating chemical programs.

DESCRIPTION OF PROCUREMENT EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
3. Defense Equipment Program	1.629 4.435	2.664 3.400	
a. Item Procurements			
(1) Decontaminating Apparatus, M12A1	(.021) (1.736)	(.232) (1.525)	Obligations incurred for in-house support and procurement.
(2) Disperser, M33A1	(000) (.160)	(.160) (000)	Obligations incurred for in-house engineering support for the M33A1 Disperser buy.
(3) Filter Unit, M8A3	(000) (.567)	(.085) (.482)	Obligations incurred for procurement and in-house engineering support for M8A3 Filter Unit to supply purified air for crewmembers of armored vehicles.
(4) Filter Unit, M13A1	(000) (.948)	(.120) (.828)	Obligations incurred for procurement and in-house engineering support for M13A1 Filter Unit used to supply purified air for crewmembers of armored vehicles.
(5) Kit f/M13A1 Filter	(.310) (000)	(000) (.310)	Obligations incurred for the procurement of kits for the M13A1 Filter.
(6) Alarm, M8-M10	(.634) (000)	(.733) (.101)	The bulk of obligations was incurred for in-house support with a small portion obligated for Government Furnished Materials and Engineering Change Orders.
(7) Maintenance Kit, M14	(.011) (000)	(000) (.011)	Obligations incurred for procurement of M14 Maintenance Kit which is used on numerous chemical type items in the field.
(8) Shelter System, M51	(.390) (000)	(.268) (.122)	Obligations incurred for in-house engineering support and for Engineering Change Orders.

DESCRIPTION OF PROCUREMENT EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
(9) Mask, M25A1	(.063) / (000)	(.042) / (.021)	The in-house obligations incurred were for engineering support while the contractual effort was for microphones which were issued to a contractor as government furnished material.
b. Production Base Projects			
(1) Manufacturing Technology for CB Filters	(000) / (.350)	(.350) / (000)	Obligations incurred for analysis of the processes used for filter production.
(2) Manufacturing Methods and Technology (MM&T) for M229 Refill Kit Component of Chemical Agent Alarm	(000) / (.585)	(.585) / (000)	Obligations incurred for in-house engineering support to improve M229 Refill Kit.
(3) MM&T Improvement & Modernization of Inspection Aids	(000) / (.089)	(.089) / (000)	Obligations incurred to conduct program for improvement of inspection aids for final inspection and surveillance testing of Chemical/Biological defensive and protective items.

SECTION 2

OBLIGATION REPORT ON BIOLOGICAL RESEARCH PROGRAM

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

DEPARTMENT OF THE ARMY

RCS DD-DRAE(SA) 1065

OBLIGATION REPORT OF RESEARCH, DEVELOPMENT, TEST
AND EVALUATION FUNDS FOR THE PERIOD
PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976
REPORTING SERVICE: DEPARTMENT OF THE ARMY
DATE OF REPORT: 30 SEPTEMBER 1976
RCS: DD-DR&E(SA) 1065

	FUNDS OBLIGATED (millions of dollars) FY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
BIOLOGICAL RESEARCH PROGRAM	-.008 17.735	11.400 6.327	During the fifteen month period of FY76 and FY7T, the Department of the Army obligated $17,203,000 for general biological research investigations and the development and test of physical and medical defensive systems. Program areas of effort were as follows:

Biological Research	
Basic Research in Life Sciences	$387,000
Total Biological Research	$387,000
Defensive Systems	
Exploratory Development	$11,658,000
Advanced Development	- 2,000
Engineering Development	4,658,000
Testing	499,000
Total Defensive Systems	$16,813,000
Simulant Test Support	$ 3,000

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DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
1. Biological Research	.000 .387	.302 .085	Life Sciences Basic Research in Support of Biological Defense Materiel: Basic research in support of biological defense materiel included studies on remote detection and on approaches to improving the XM19 Biological Agent Detector. Theoretical studies on remote detection of biological agents in the atmosphere, furnished estimates of the absorption and scattering efficiencies of microbiological aerosols subjected to ultraviolet irradiation, and estimates of the ambient fluorescence background of the atmosphere which supported the potential for a second-generation detection concept. Time-intensity chemiluminescence response patterns were obtained for over 20 different microbiological materials using redesigned instrumentation with which the samples were differentiated into three characteristic response groups at the 14°C optimum reaction temperature. In basic research in bioidentification, rapid identification of microorganisms was achieved by mass spectrometry analysis of the purine and pyrimidine composition of their nucleic acids by contract supported effort at the Mass Spectrometry Research Center, Stanford Research Institute. Identification was accomplished in one hour by application of upgraded procedures for extracting, purifying and hydrolyzing nanogram quantities the nucleic acids followed by field ionization mass spectroscopy-fingerprint analyses of the released purines and pyrimidines.
a. Basic Research in Life Sciences	(.000) (.387)	(.302) (.085)	
			Basic research on new concepts for biological decontamination focused on the feasibility of direct neutralization of airborne biological agents. Theoretical studies have developed models for lactic acid vapor disinfection of vegetative bacteria in aerosol particles. The significant reduction in casualties predicted by the model is supported by laboratory data of effective disinfection of bacterial aerosols with practicable concentrations of lactic acid disseminated as vapors or droplets.
2. Defensive Equipment Program	-.008 16.821	12.630 4.183	
			Exploratory Development effort:
a. Physical Defense Against Biological Agents	(.000) (1.278)	(1.036) (.242)	Physical Defense Against Biological Attack:
			1. The first phase of in-house studies to further anti-aerosol and protective counter cloud technology associated with the chemical disinfection of biological aerosols was completed and

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

a report prepared. The effectiveness of lactic acid droplets as a decontaminant for vegetative bacterial aerosols in an enclosed chamber was demonstrated. A contract to expand these studies and to pursue the development of a biological cloud neutralization system was awarded. The in-house chemical screening program for new vapor phase decontaminants is continuing in an effort to find a suitable replacement for beta-propiolactone and formaldehyde. Several potential disinfectants have been selected for further study. A contract package was completed for the Exploratory Development of a decontamination system for biologically contaminated personnel, equipment and enclosures. The proposed procurement is a four year technical effort planned for FY 77 through FY 80. The in-house chemical screening program for potential disinfectants has resulted in the selection of four candidates for further study. Biological leakage tests leading towards development of new test technology were performed using the M9A1 protective mask as the test fixture.

2. Time-rate chemiluminescence detector performance was evaluated for aerosolized pathogens at Fort Detrick, MD, to further establish the applicability for goup specific identification of aerosolized materials. Efforts were made to improve the response separation between biological groups for identification. Data are being evaluated. A biological All Clear Kit for indication of agent presence following biological attack, Exploratory Development program was initiated. The developmental viability response indicator systems under study are resazurin and catalase. Responses of the two systems to pathogens we e obtained; however, improvements in sensitivity are required to establish feasiblity of these approaches for further development. Performance of the Pattern Acquisition and Correlation Technique system with improved pattern recognition electronics and use of a digital adaptive alarm logic was demonstrated for biological aerosols and ambient background. The theoretical feasibliity of remote detection of biological aerosols in the atmosphere has been indicated as a result of contract and in-house analysis . Thus a contract was awarded to further establish the capability of remote detection using intrinsic fluorescence. Evaluation of bacterial path gens of Biological Defense importance and tissue antibodies procured from the Naval Biosciences Laboratory are being assessed in the chemiluminescent device as a potential means of achieving group specificity.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
b. Biological Defense Materiel concepts	(-.002) (.000)	(.000) (-.002)	Prior year Advanced Development deobligation resulted from withdrawal of residual funds following completion effort.
			Advanced Development effort:
c. Biological Defense Materiel	(-.006) (4.664)	(2.628) (2.030)	Prior year deobligation as a result of residual funds withdrawn upon completion of effort.
			Engineering Development effort:
			Various functional configurations of the XM19 Biological Agent Detector were field tested and evaluated. The results of these tests indicated that the design employing a static reaction cell for monitoring the chemiluminescent reaction was superior to a continuous flow cell design. Thus emphasis was placed on the continued development of the static cell concept. Among the principal features this design offers is a significant improvement in the reproducibility in detector response to simulant challenges and a major reduction in the volume of agent required to operate the XM19 Biological Agent Detector over its mission interval. In-house effort was directed toward the detailed examination of the design of the new components employed in the static cell design, measuring the parameters which determine their performance, and testing and evaluating alternate designs. As part of these tests, an aerosol testing facility capable of presenting large aerosol particles was assembled. It became evident that additional equipment was needed to establish the range of particle sizes required to thoroughly evaluate the sampling capability of both the XM19 and XM2 biological sampler. Action was taken to procure the needed equipment and to make the necessary modifications to the existing facility so that a full spectrum of aerosols can be generated and quantitatively assessed. An XM2 design leading toward a self-contained disposable aerosol sample reservoir was also tested and evaluated. This configuration offers a substantial simplification and reduction of logistics burden. The multi-year prime contract for Engineering Development of the subject system is under negotiation. To provide the initial impetus to this program, several small contracts have or will be awarded to critically examine selective design areas important to the initial Engineering Development program. These include the design of the XM2, alternate aerosol concentrator designs, aerosol generating equipment for use in testing, the design of the electronic alarm logic for the XM19,

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
			and further improvement in suppressing the effects of certain dust aerosols on the performance of the XM19. A contractor is developing process data suitable for the preparation of procurement specifications for the luminol reagent and for the precoated impaction tape used in the XM19. Also, alternate tape designs are being prepared for evaluation to determine if improvements in the specificity of the impaction/wash process can be achieved. Another contractor is conducting a detailed experimental program for the accumulation of data for a computer analysis by varying the formulation of the reagent and other parameters used in the XM19. The analyses should result in optimization of variables for the best operational performance. A third contractor has redesigned the multi-nozzle concentrator resulting in fewer parts, simpler mechanical design and reduction of the noise level. Prototypes were fabricated and are presently being evaluated in-house.
Biological Defense Against Biological Agents:	0 10.904	7.088 3.816	This multifaceted program is a highly specialized field of infectious disease research because abnormal routes of administration (aerosols) many times alter the normal pattern of disease agents. Incidence of disease from Biological Warfare (BW) agents is significantly higher than that observed in natural infection with the same agent due to concentration of the agent in a small operational area. Agents used in BW, due to genetic engineering, stabilization, and use of resistant strains may present a different pattern for diagnosis. The United States recognizes its vulnerability to BW attacks, and the possibility that this type of weapon may be used against us and our allies. Medical defense depends on protection against illness, and, where protection cannot be provided, rapid diagnosis and successful treatment of those illnesseas which occur. The investment strategy in this program is based on envisioned military operations, medical and scientific state-of-the-art, as well as continuous coordination and data input from the medical intelligence community. Within the framework of this strategy, the US Army Medical Research of Infectious Disease (USAMRIID) research program emphasizes investigations on problems associated with the medical defense against BW agents and those microorganisms which require special containment facilities. The program has 3 principle task-related goals:

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DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

(1) Pathogenesis of Military Important Infections; (2) Prevention and Treatment of Biological Agent Casualties; and (3) Rapid Diagnosis of Biological Agents. Significant progress in each of these categories is illustrated by the following examples:

Patnogenesis of Infections of Military Importance:

The goal of this important area is to define mechanisms of both disease progression and defensive responses within the infected host involving a broad, multidisciplined study of the infectious proces., including metabolic, endocrine, and biochemical studies, interaction of vaccines and toxins, and the effects of radiation on infection. Investment pay-offs in this area include:

a. Tissue enzymes (adenyl cyclase) and hormones (prostaglandins) found to be released early in the inflammation proces of infection.

b. Early disease pattern (depression in amino acids and increase in acute phase globulins) defined in the infectious process.

c. The immune response following irradiation was found to be delayed. This is extremely important in the protection of the soldier against disease in a nuclear environment.

d. A major breakthrough was accomplished in developing the squirrel monkey as a model for studying respiratory infections. The immediate benefit in this is exampled by the recent establishment of a model for swine influenza.

e. A new and novel technique has been developed for scanning electron microscopy that enable one to visualize infection early in the disease. Virus particles can be detected as early as 7-1/2 hours after virus adsorption to cells.

Prevention and Treatment of Biological Casualties:

Since mass immunization against all potential Biological Warfare (BW) agents is neither feasible nor practical; vaccines are being developed against key microorganisms and toxins which experience and current intelligence data suggests to be of potential geographical military importance. New methods of immunoprophylaxis and therapy are being extensively studied, particularly

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

in the antiviral area. Experimental approaches include: Develop new vaccines and toxins; improve efficacy of existing vaccines. Cell-mediated studies; Efficacy screening of antiviral compounds; Aerogenic administration of antiviral compounds. Benefits include:

a. Vaccine development against potential BW agents such as anthrax, Venezuelan equine encephalomyelitis (VEE), tularemia, plaque, and Q fever has been completed. Vaccines against chikungunya and Rift Valley fever arbovirus infections in Africa and SE Asia, are in final development. Vaccines against Dengue type 2, Mayaro virus, and sinbis virus found in South America, Africa, and SE Asia are in the early stages of development.

b. Two classes of drugs, tilorone and polyinosinic - polycytidylic acid (PIC), have been shown effective in early protection against VEE and yellow fever by inducing interferon, a non-specific protective substance. Rimantadine and amantadine have exhibited both prophylactic and therapeutic effects against influenza.

c. Lymphocyte transformation assay has been developed to study cell-mediated responses of specified disease agents and to evaluate the cellular effects of vaccines developed and commonly employed at USAMRIID.

d. PIC has been shown to be a potent drug for inducing better and quicker protection against VEE by increasing antibody responses. This drug also increases antibody responses to swine influenza.

Rapid Diagnosis of Biological Agents: This critical block of research supported by both in-house and contract research at a cost of 1.5 million dollars, is aimed at rapidly identifying the causative agent in any BW attack so that appropriate supportive measures can be initiated earlier than is now possible in the current state-of-the-art. Subtle changes in the host's biochemical metabolic status serve asindicators of incubating infections. We must utilize and exploit methodology in various fields of science such as:

1. Immunoelectrophoresis- to rapidly identify the causative organisms by immunological means.

2. Mass spectrometry- to identify metabolites in the body fluids indicative of types of organisms.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

3. Laser Beam Scattering- to rapidly identify the morphology of the causative organism.

In order for rapid identification of BW agents to be a viable part of the total medical defense program, it must be approached on three interrelated levels: (1) Whether or not infection is in progress; (2) What is the general nature of the infectious organism ie bacterial, rickettsial, or viral; and (3) What is the specific agent. The need for rapid diagnosis was exemplified in the recent "Legionaire's disease" outbreak in Philadelphia, PA. While it is not suspected that this was the result of a BW agent, the diagnostic procedures routinely used were not adequately responsive to affect supportive medical care, and the identification of the etiology is still in doubt. Progress in pursuit of rapid identification is included in the following:

a. Metabolic process (oxidation of glucose and increased Deoxyribonucleic acid synthesis can be used as indicators 4 to 6 hours post infection with herpes virus.

b. Procedures have been developed whereby alterations in the trace metals levels in conjunction with routine blood chemistry and analysis tests can detect early infection and differentiate between a bacterial (typhoid fever) and viral (sandfly fever) infection.

c. An immunoelectrophoresis procedure has been developed that affords rapid identification of a variety of viruses in clinical specimens within 48 hours. Modification to a wide variety of agents may provide a means to quickly identify specific BW agents for medical treatment.

d. The development of mass spectrometry procedures now make it possible to positively identify a group of metabolites from the urine of patients with hepatitis. This procedure is being simplified for faster results in order to develop a rapid diagnostic tool for identification of BW agents.

Significant advances have been made in development of vaccines, animal models of disease, treatment of disease, early diagnosis of infection, and in fundamental knowledge of infectious disease process. Important tissue culture and cost saving advances have been made in technical aspects of large scale vaccine development. Research continues in these areas with con-

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
			stant interaction with other Department of Defense agencies in all collaboration research and data information collection to obtain fundamental information upon which to base development of preventive and therapeutic measure and broaden our base for protection of the soldier from infectious disease.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
e. Foreign Biological Threat	(.000) (.392)	(.236) (.156)	Operations research studies were conducted to evaluate and assess the biological threat to the United States and to US military forces throughout the world. During this period, eleven studies were in progress:

1. Study 1: Target Vulnerability Assessment: A two-volume report was published; volume 1 and executive summary, and volume 2, the complete report (Biological Vulnerability Assessment). The report is an analysis of the vulnerability of a specific front to a biological attack, based on political, military and environmental factors associated with that target area.

2. Study 3: Response Protocol: A report on this study was completed during this period, titled, Biological Defense Protocol. The report is an assessment of current capabilities and biological defense requirements for the US Army in the field. The current capability is based on current attitudes regarding biological defense and training and equipment devoted to biological defense. Information was obtained from several sources. An analysis was made of training preparedness requirement in response to the biological threat.

3. Study 5: Target Vulnerability Analog Definition: This study was completed and a report was published, (Analog Environmental Parameters for Assessing Target Vulnerability). An analysis was made of environmental conditions at selected sites to determine the duration and frequency of occurrence of conditions that would render the site a susceptible target to a biological attack. For the stringent conditions for attack that were imposed, the frequency of suitable conditions was relatively high.

4. Study 8: Target Vulnerability: This study involves an assessment of the meteorology and topography, identification of strategic and tactical targets, and identification of possible modes of attack against US forces, should they be involved in operations under this scenario. During this period, a literature review was initiated. Report is scheduled for completion in FY 77.

5. Study 10: Biological Detector Effectiveness for Bomblet Attacks: This study will evaluate the detection capabilities for an on target bomblet against US military forces based on current detector arrays. During this report period distribution patterns for biological

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY C*Y	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION

bomblets have been defined and orientation on target has been examined to establish cloud travel patterns and cloud emergence. Requirements for detector density and location will be examined. Report is scheduled for completion in FY 77.

6. Study 11: Role of Large Particle Size Aerosols in Biological Defense: This study will assess US troop vulnerability from biological attack involving large particle size aerosols. During this period an analysis of the physical properties of particles in the 20 micron diameter range and the relation of particle size to the numbers, survival, and dosage of microorganisms in such particles was accomplished. A report is in preparation. Phase two will be an examination of data available for several organisms and the effect of particle size on animal infectivity for these organisms and is scheduled for completion in FY77.

7. Study 12: Biological Detector Criteria for Fixed Installations: This study will develop procedures to determine the effectiveness of various biological detector criteria in preventing casualties for fixed installations. During this period analysis of building ventilation characteristics for a variety of climatological conditions was completed. Report is scheduled for publication in FY77.

8. Study 15: Biological Cloud Patterns and Profiles: This study will summarize all past test data on biological cloud patterns and profiles. During this period effects of wind speed and wind direction shears on instantaneous point and line source clouds were examined. The magnitude of the effect of these shears on the cloud distribution in space and time was studied for various terrain situations. The adequacy of current diffusion models to handle these situations will be investigated for possible modification. Report is scheduled for completion in FY 77.

9. Study 17: Analysis of the Validity and Integrity of Biological Treaties: This study will provide in the context of current and projected international relations, an analysis of the validity and integrity of biological treaties. During this period an examination of the following was accomplished: 1) Events which contributed to the formulation and adoption of biological treaties; 2) Strengths and weaknesses in the provision of these treaties; 3) Alternative or unspecified procedures for assuring the integrity and validity of treaties. Study will be published in FY 77.

DESCRIPTION OF RDTE EFFORT	FUNDS OBLIGATED (millions of dollars) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
			10. Study 18: Minimum Capability for Biological Threat: This study will assesss the technological requirements for development of biological weapons to meet a number of potential roles for use by groups having a low level of technical capability. During this period an analysis of the existence of the acquisition of the technical capability to produce, stockpile and transport biological materiel for use in biological weapon systems was accomplished. Study will be completed in FY 77.
			11. Study 19: Refinement of Target Vulnerability Analog Criteria: This study will provide for further characterization of target vulnerability analogs and will be applied to a number of sites and larger areas. During this period, refinement of analysis techniques has been initiated. Study is scheduled for completion in FY78.
f. Army Materiel Development Tests	(.000) (.107)	(.107) (.000)	Obligations were incurred in the modification of an inclosed test chamber and to check out test procedures prior to testing of the XM19 Biological Agent Detector. Testing of the XM19 is scheduled for FY77.
3. Simulant Test Support	.000 .003	.003 .000	Obligations were incurred in the reporting of a test program which was in response to Unified and Specified Commands and Service requirements. Test was designed to evaluate the relationship between biological decay rate data between the mobile van/microfilament technique and free floating aerosols. Final report was published during this report period.

OBLIGATION REPORT OF PROCUREMENT FUNDS
FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976
REPORTING SERVICE: DEPARTMENT OF THE ARMY
DATE OF REPORT: 30 SEPTEMBER 1976
RCS DD-DRE(SA) 1065

	FUNDS OBLIGATED (millions of dollars)		EXPLANATION OF OBLIGATION
	PY / CFY	IN-HOUSE / CONTRACT	
BIOLOGICAL RESEARCH PROGRAM	.000 / .000	.000 / .000	During the fifteen month period, FY76 & FY7T, the Department of the Army obligated $0 for procurement activities associated with biological defensive equipment and production base projects.

SECTION 3

OBLIGATION REPORT ON ORDNANCE PROGRAM

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

DEPARTMENT OF THE ARMY

RCS DD-DR&E(SA) 1065

OBLIGATION REPORT OF RESEARCH, DEVELOPMENT, TEST
AND EVALUATION FUNDS FOR THE PERIOD
REPORTING SERVICE: DEPARTMENT OF THE ARMY
DATE OF REPORT: 30 SEPTEMBER 1976
RCS DD-DR&E(SA) 1065

	FUNDS OBLIGATED (millions of dollars) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
ORDNANCE PROGRAM*	-.002 / 8.122	7.775 / .345	During the fifteen month period FY76 and FY7T, the Department of the Army obligated $8,120,000 for general research investigations, development and test of smoke, flame, incendiary, herbicide, riot control agents and weapons systems, and other support equipment. Program areas of effort concerned with these obligations were as follows:

Smoke, Flame, and Incendiary Program	$5,213,000
*Herbicide Program	- 2,000
Riot Control Program	1,775,000
Other Support Equipment Program	912,000
Test Support	222,000
Total Ordnance Program	$8,120,000

*Department of the Army research on the herbicide program has been phased out.

OBLIGATION REPORT OF PROCUREMENT FUNDS
FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976
REPORTING SERVICE: DEPARTMENT OF THE ARMY
DATE OF REPORT: 30 SEPTEMBER 1976
RCS DD-DRAE(SA) 1062

	FUNDS OBLIGATED (millions of dollars)		
	FY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
ORDNANCE PROGRAM	8.761 8.766	9.247 6.280	During the fifteen month period FY76 and FY7T, the Department of the Army obligated $17,527,000 for procurement activities associated with smoke, flame, incendiary, herbicide, riot control agents, weapons systems and other support equipment. Program areas of effort concerned with these obligations were as follows:

Smoke, Flame & Incendiary Program	$11,502,000
Herbicide Program	0
Riot Control Program	375,000
Other Support Equipment	5,650,000

SECTION 4

ANNUAL REPORT ON CHEMICAL AND BIOLOGICAL RESEARCH PROGRAM OBLIGATIONS

ADJUSTMENT SUMMARY

TO REPORT FOR THE SEMIANNUAL PERIOD 1 JANUARY 1975 THROUGH 30 JUNE 1975

DEPARTMENT OF THE ARMY

RCS DD-DR&E(SA) 1065

RCS DD-DR&E(SA)1065
Adjustment Summary to the Semiannual Period 1 January 1975 through 30 June 1975

SECTION I - CHEMICAL WARFARE PROGRAM

PAGE	DESCRIPTION	FROM	TO
	Under Explanation of Obligations, change figures as follows:		
1	First line, "Department of the Army" obligated	$4,968,000	$5,017,000
	Chemical Research	268,000	325,000
	Basic Research in Life Sciences	170,000	230,000
	Exploratory Development	98,000	95,000
	Lethal Chemical Program	242,000	230,000
	Exploratory Development	22,000	14,000
	Advanced Development	-15,000	-19,000
	Engineering Development	-250,000	-250,000
	Testing	485,000	485,000
	Incapacitating Chemical Program	32,000	31,000
	Exploratory Development		
	Defensive Equipment Program	4,426,000	4,431,000
	Exploratory Development	3,256,000	3,252,000
	Advanced Development	599,000	604,000
	Engineering Development	376,000	380,000
	Testing	195,000	195,000
	Simulant Test Support	0	0

Under Funds Obligated, change figures as follows:

PAGE	DESCRIPTION	FROM PY / CY	FROM In-House / Contract	TO PY / CY	TO In-House / Contract
1	Chemical Warfare Progam	-.003 / 5.001	3.221 / 1.747	-.005 / 5.070	3.290 / 1.735
3	1. Chemical Research	.000 / .268	.189 / .079	-.003 / .328	.249 / .076
3	a. Basic Research in Life Sciences	(.000) / (.170)	(.140) / (.030)	(.000) / (.230)	(.200) / (.030)
5	b. General Chemical Investigations	(.000) / (.098)	(.049) / (.049)	(-.003) / (.098)	(.049) / (.046)
9	2. Lethal Chemical Programs	-.021 / .263	.248 / -.006	-.033 / .263	.244 / -.014
9	a. Agent Investigations & Weapons Concepts	(.000)	(.022)	(-.008)	(.022)
11	c. Tactical Weapons Systems (1) Advanced Development	(-.018) / (.000)	(-.012) / (-.006)	(-.022) / (.000)	(-.016) / (-.006)
13	3. Incapacitating Chemical Program	.000 / .032	.032 / .000	-.001 / .032	.031 / .000
13	a. Agent Investigations & Weapon Concepts	(.000) / (.032)	(.032) / (.000)	(-.001) / (.032)	(.031) / (.000)
13	4. Defense Equipment Program	-.012 / 4.438	2.752 / 1.674	-.016 / 4.447	2.758 / 1.673
13	a. Physical Protection Investigations	(-.012) / (1.145)	(.343) / (.790)	(-.016) / (1.145)	(.340) / (.789)

PAGE	DESCRIPTION	FROM		TO	
		PY CY	In-House Contract	PY CY	In-House Contract
17	b. Advanced Development of Defensive Systems	(.000) (.599)	(.103) (.496)	(.000) (.604)	(.108) (.496)
18	c. Collective Protection System	(.000) (.083)	(.016) (.067)	(.000) (.085)	(.018) (.067)
18	d. Warning & Detection System	(.000) (.293)	(.100) (.193)	(.000) (.295)	(.102) (.193)

SECTION II - BIOLOGICAL RESEARCH PROGRAM

PAGE	DESCRIPTION	FROM	TO
1	First line. "Department of the Army obligated..."	4,888,000	4,869,000
	Biological Research	50,000	50,000
	Basic Research in Live Sciences	50,000	50,000
	Exploratory Development		
	Defensive Systems	4,838,000	4,819,000
	Exploratory Development	4,122,000	4,103,000
	Advanced Development	285,000	285,000
	Engineering Development	428,000	428,000
	Testing	3,000	3,000
	Simulant Test Support	0	0

SECTION II - BIOLOGICAL RESEARCH PROGRAM

Under Funds Obligated, change figures as follows:

PAGE	DESCRIPTION	FROM		TO	
		PY / CY	In-House / Contract	PY / CY	In-House / Contract
2	2. Defense Equipment Program	-.003 / 4.841	4.511 / .327	-.022 / 4.841	4.492 / .327
5	e. Foreign Biological Threat	(.000) / (.157)	(.132) / (.025)	(-.019) / (.157)	(.113) / (.025)

SECTION III - ORDNANCE PROGRAM

Under Funds Obligated, change figures as follows:

PAGE	DESCRIPTION	FROM		TO	
		PY CY	In-House Contract	PY CY	In-House Contract
1	First line, "Department of the Army obligated..."	1,446,000		1,496,000	
1	Ordnance Program	.182 1.264	1.024 .422	.182 1.314	1.030 .466
	Smoke, Flame & Incendiary Program	476,000		476,000	
	Herbicide Program	233,000		239,000	
	Riot Control Program	234,000		244,000	
	Other Support Equipment Program	350,000		384,000	
	Test Support	153,000		153,000	

OBLIGATION REPORT ON CHEMICAL WARFARE - BIOLOGICAL RESEARCH PROGRAM

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

DEPARTMENT OF THE NAVY

RCS: DD-DR&E(SA) 1065

SECTION I

OBLIGATION REPORT ON CHEMICAL WARFARE PROGRAM

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

DEPARTMENT OF THE NAVY

RCS: DD-DR&E(SA) 1065

OBLIGATION REPORT OF RESEARCH, DEVELOPMENT, TEST
AND EVALUATION FUNDS FOR THE PERIOD
1 JULY 1975 THROUGH 30 SEPTEMBER 1976
REPORTING SERVICE: DEPARTMENT OF THE NAVY
DATE OF REPORT: 30 SEPTEMBER 1976
RCS: DD-DR&E(SA) 1065

DESCRIPTION OF EFFORT RDTE	FUNDS OBLIGATED ($ in Millions) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
CHEMICAL WARFARE PROGRAM	.000 1.060	.792 .268	During the period 1 July 1975 through 30 September 1976, the Navy obligated $1,060,000 for research and development efforts.
1. Defensive Equipment Program	.000 1.060	.792 .268	
a. Exploratory Development Chemical/Biological Defense Technology	.000 .200	.140 .060	Funds support defense requirements analysis, development of automated chemical/biological detection systems, joint development of a new protective mask and study assistance to determine cost to provide shipboard protection to new type naval ships.
b. Exploratory Development	.000 .200	.200 .000	The objectives of this program are: (1) develop a coordinated, unified RDT&E Chemical/Biological defense program to interpret operational requirements, (2) to coordinate the response to these requirements, (3) to advise & assist US Navy Materiel Command in developing & coordinating these requirements with the Army and Air Force.
c. Engineering Development	.000 .660	.452 .208	The purposes of this program are: (1) provide US Navy ships with Chemical Warfare advanced warning capabilities utilizing passive infrared techniques, and (2) to provide US Navy ships with a chemical agent point sampling detector and surface contamination monitor.

OBLIGATION REPORT OF RESEARCH, DEVELOPMENT, TEST
AND EVALUATION FUNDS FOR THE PERIOD
1 JULY 1975 THROUGH 30 SEPTEMBER 1976
REPORTING SERVICE: DEPARTMENT OF THE NAVY
DATE OF REPORT: 30 SEPTEMBER 1976
RCS: DD-DR&E(SA) 1065

DESCRIPTION OF EFFORT	FUNDS OBLIGATED ($ in Millions) PY / CFY	IN-HOUSE / CONTRACT	EXPLANATION OF OBLIGATION
Procurement			
CHEMICAL WARFARE PROGRAM	.015 .018	.033 .000	During the period 1 July 1975 through 30 September 1976, the Department of the Navy obligated $18,000 for procurements associated with chemical warfare defensive equipment.
1. Defensive Equipment Program	.015 .018	.033 .000	
a. Protective Clothing	.015 018	.033 .000	Obligations to cover the procurement of chemical warfare protective clothing for distribution to Navy ships and stations.

SECTION 3

OBLIGATION REPORT ON ORDNANCE PROGRAM

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

DEPARTMENT OF THE NAVY

RCS: DD-DR&E(SA) 1065

OBLIGATION REPORT OF RESEARCH, DEVELOPMENT, TEST
AND EVALUATION FUNDS FOR THE PERIOD
1 JULY 1975 THROUGH 30 SEPTEMBER 1976
REPORTING SERVICE: DEPARTMENT OF THE NAVY
DATE OF REPORT: 30 SEPTEMBER 1976
RCS: DD-DR&E(SA) 1065

DESCRIPTION OF EFFORT	FUNDS OBLIGATED ($ in Millions) PY CFY	IN-HOUSE CONTRACT	EXPLANATION OF OBLIGATION
Procurement			
ORDNANCE PROGRAM	.198	.000	Termination cost for firebomb MK 343 fuze contract
	.000	.198	

DEPARTMENT OF THE AIR FORCE

ANNUAL REPORT ON CHEMICAL WARFARE

AND BIOLOGICAL RESEARCH PROGRAMS

(1 JULY 1975 - 30 SEPTEMBER 1976)

RCS: DD-DR&E(SA) 1065

30 SEPTEMBER 1976

SECTION 1

OBLIGATION REPORT OF

CHEMICAL WARFARE LETHAL AND INCAPACITATING AND DEFENSIVE EQUIPMENT PROGRAMS

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

RCS: DD-DR&E(SA) 1065

DEPARTMENT OF THE AIR FORCE

30 SEPTEMBER 1976

OBLIGATION REPORT OF RESEARCH, DEVELOPMENT, TEST & EVALUATION FUNDS
FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976
REPORTING SERVICE: DEPARTMENT OF THE AIR FORCE
RCS: DD-DR&E 1065
FUNDS OBLIGATED

(Thousands of Dollars)

DESCRIPTION OF RDTE EFFORT	Prior Year / Current Year	In-House / Contract	EXPLANATION OF OBLIGATIONS
Defensive Equipment Progra:			
Exploratory Development	0 / 0	0 / 0	
Engineering Development	554 / 942	1,086 / 410	Development and testing of agent detection devices and further development of Modification Kits for structures. Evaluation and development of various items of personnel protective equipmer
Total Defensive	554 / 942	1,086 / 410	
Total RDTE Obligations	554 / 942	1,086 / 410	

SECTION 2

BIOLOGICAL RESEARCH PROGRAM OBLIGATIONS

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

DEPARTMENT OF THE AIR FORCE

RCS: DD-DR&E(SA) 1065

30 SEPTEMBER 1976

N E G A T I V E

SECTION 3

RDT&E AND PROCUREMENT OBLIGATIONS FOR

FLAME, SMOKE, INCENDIARY, RIOT CONTROL AND

HERBICIDE AGENT/MUNITION SYSTEMS

FOR THE PERIOD 1 JULY 1975 THROUGH 30 SEPTEMBER 1976

DEPARTMENT OF THE AIR FORCE

RCS: DD-DR&E(SA) 1065

30 SEPTEMBER 1976

N E G A T I V E

SECTION 4

OBLIGATION REPORT OF

CHEMICAL WARFARE LETHAL AND INCAPACITATING AND DEFENSIVE EQUIPMENT PROGRAMS

ADJUSTMENT SUMMARY

TO REPORT FOR THE PERIOD 1 JANUARY 1975 THROUGH 30 JUNE 1975

DEPARTMENT OF THE AIR FORCE

RCS: DD-DR&E(SA) 1065

N E G A T I V E